

CLAIMS

1. (Currently Amended) A method for detecting an anomaly on a top surface of a substrate, or within the substrate, comprising:

directing a first radiation beam having a first ultraviolet or deep ultraviolet wavelength to illuminate a first spot on the top surface of the substrate at a first non-zero angle measured from a normal direction to the top surface;

directing a second radiation beam having a second wavelength to illuminate a second spot on the top surface of the substrate at a second angle measured from a normal direction to the top surface, wherein the second wavelength is ~~not equal to~~ greater than the first wavelength, so that radiation from the second beam penetrates the surface of the substrate by a distance greater than that by radiation from the first beam;

causing relative motion between the first and second radiation beams and the top surface of the substrate so that the spots scan paths on the top surface;

detecting radiation from the first radiation beam scattered by the top surface in the first spot to provide a single output corresponding to a position of the first spot on the top surface; and

detecting radiation from the second radiation beam scattered by the top surface in the second spot to provide a single output corresponding to a position of the second spot on the top surface; and

generating from the outputs first data set(s) containing only data on anomalies at or substantially at the surface of the substrate and second data set(s) containing data on anomalies away from the surface of the substrate, so that anomalies at or substantially at the surface of the substrate are detectable independently from anomalies away from the surface of the substrate from the data sets.

2. Cancelled.

3. (Original) The method of claim 1, further comprising documenting the presence of an anomaly if the detected radiation shows that the first radiation beam was scattered upon interacting with the top surface.

4. (Original) The method of claim 1, further comprising documenting the presence of an anomaly if the detected radiation shows that the second radiation beam was scattered upon interacting with the top surface.
5. (Original) The method of claim 1, further comprising comparing radiation detected from the first radiation beam to radiation detected from the second radiation beam to determine whether the anomaly comprises a COP or a particle.
6. (Original) The method of claim 1, wherein the first wavelength is around 266 nanometers.
7. (Original) The method of claim 1, wherein the first wavelength is around 355 nanometers.
8. (Original) The method of claim 1, wherein the first wavelength is a wavelength in the ultraviolet spectrum of radiation.
9. (Original) The method of claim 1, wherein the second wavelength is around 532 nanometers.
10. (Original) The method of claim 1, wherein the second wavelength is a wavelength in the visible spectrum of radiation.
11. (Original) The method of claim 1, wherein the first wavelength is around 266 nanometers and the second wavelength is around 532 nanometers.
12. (Original) The method of claim 1, wherein the first wavelength is around 355 nanometers and the second wavelength is around 532 nanometers.

13. (Original) The method of claim 1, wherein the first wavelength is in the ultra-violet spectrum of radiation and the second wavelength is in the visible spectrum of radiation.

14. (Previously presented) The method of claim 1, wherein the first angle is around 70 degrees to a normal direction to the top surface.

15. (Previously presented) The method of claim 1, wherein the second angle is around zero degrees to a normal direction to the top surface.

16. (Original) The method of claim 1, wherein the directing of a first radiation beam and the directing of a second radiation beam are performed simultaneously.

17. (Original) The method of claim 1, wherein the detecting of radiation from the first radiation beam and the detecting of radiation from the second radiation beam are performed simultaneously.

18. (Original) The method of claim 1, wherein the first radiation beam comprises a laser beam.

19. (Original) The method of claim 1, wherein the second radiation beam comprises a laser beam.

20. (Original) The method of claim 1, wherein the detecting of radiation from the second radiation beam comprises detecting scattered radiation from the second radiation beam and avoiding reflected radiation from the second radiation beam.

21. (Currently amended) The method of claim 12, further comprising documenting the presence of an anomaly if the detected radiation shows an increase in the amount of scattered radiation produced by the first radiation beam.

22. (Currently amended) The method of claim 12, further comprising documenting the presence of an anomaly if the detected radiation shows an increase in the amount of scattered radiation produced by the second radiation beam.

23. (Currently Amended) A method for detecting an anomaly on a top surface of a substrate, or within the substrate, comprising:

directing a first radiation beam having a first wavelength to illuminate a first spot on the top surface of the substrate at a first non-zero angle measured from normal, wherein the first wavelength is in the ultraviolet or deep ultraviolet spectrum of radiation;

directing a second radiation beam having a second wavelength to illuminate a second spot on the top surface of the substrate at a second angle measured from normal, wherein the second wavelength is in the visible spectrum of radiation;

detecting radiation from the first and second radiation beams;

causing relative motion between the first and second radiation beams and the top surface of the substrate, so that the spots scan paths on the top surface, wherein said detecting detects radiation scattered by the top surface ~~in the first and second spots to provide one or more outputs~~ ~~a first single output in response to the scattered radiation in the first beam corresponding to a position of the first spot on the top surface in one of the scan paths, and a second single output in response to the scattered radiation in the second beam corresponding to a position of the second spot on the top surface in one of the scan paths;~~

generating from the outputs first data set(s) containing only data on anomalies at or substantially at the surface of the substrate and second data set(s) containing data on anomalies away from the surface of the substrate, so that anomalies at or substantially at the surface of the substrate are detectable independently from anomalies away from the surface of the substrate from the data sets; and

documenting the presence of an anomaly if the ~~detected radiation data sets~~ shows an increase in the amount of scattered radiation produced by the first radiation beam or the second radiation beam.

24. (Currently Amended) A system for detecting an anomaly on a top surface of a substrate, or within the substrate, comprising:

a device providing a first wavelength radiation and a second wavelength radiation to illuminate the top surface, said first wavelength being ultraviolet or deep ultraviolet;

optics focusing the first wavelength radiation into a first radiation beam at an oblique first angle to the top surface to illuminate a first spot on the top surface and focusing the second wavelength radiation into a second radiation beam at a second angle to a normal direction to top surface to illuminate a second spot on the top surface, wherein the second wavelength is greater than the first wavelength, so that radiation of the second wavelength penetrates the surface of the substrate by a distance greater than that by radiation of the first wavelength;

means for causing relative motion between the first and second radiation beams and the top surface of the substrate, so that the spots scan paths on the top surface; and

a detector mounted to detect radiation scattered by the top surface in the first or second spot to provide a first single output in response to the scattered radiation in the first beam corresponding to a position of the first spot on the top surface in one of the scan paths, and a second single output in response to the scattered radiation in the second beam corresponding to a position of the second spot on the top surface in one of the scan paths; and

means for generating from the outputs first data set(s) containing only data on anomalies at or substantially at the surface of the substrate and second data set(s) containing data on anomalies away from the surface of the substrate, so that anomalies at or substantially at the surface of the substrate are detectable independently from anomalies away from the surface of the substrate from the data sets.

25. (Original) The system of claim 24, further comprising a beamsplitter to separate the first radiation beam from the second radiation beam.

26. (Previously presented) The system of claim 24, further comprising a collector that is rotationally symmetric about a line and that is operable to collect radiation and focus the radiation onto the detector.

27. (Original) The system of claim 24, wherein the radiation source is provided by a laser source.
28. (Original) The system of claim 24, wherein the first wavelength is around 266 nanometers.
29. (Original) The system of claim 24, wherein the first wavelength is around 355 nanometers.
30. Cancelled.
31. (Original) The system of claim 24, wherein the second wavelength is around 532 nanometers.
32. (Original) The system of claim 24, wherein the second wavelength is a wavelength in the visible spectrum of radiation.
33. (Original) The system of claim 24, wherein the first wavelength is around 266 nanometers and the second wavelength is around 532 nanometers.
34. (Original) The system of claim 24, wherein the first wavelength is around 355 nanometers and the second wavelength is around 532 nanometers.
35. (Original) The system of claim 24, wherein the first wavelength is a wavelength in the ultraviolet spectrum of radiation and the second wavelength is a wavelength in the visible spectrum of radiation.
36. (Previously presented) The system of claim 25, further comprising at least one mirror mounted to direct the first radiation beam at the top surface and to direct the second radiation beam at the top surface.

37. (Previously presented) The system of claim 25, wherein the first beam is around 70 degrees measured from a normal direction to the top surface.

38. (Previously presented) The system of claim 25, wherein the second angle is around zero degrees from a normal direction to the top surface.

39. (Original) The system of claim 27, wherein the laser source is a solid-state laser.

40. (Original) The system of claim 27, wherein the laser source can vary the wavelength of emitted radiation using one or more crystals.

41. (Original) The method of claim 1, further comprising comparing radiation detected from the first radiation beam to radiation detected from the second radiation beam to determine whether the anomaly is located on the top surface or below the top surface of the substrate.

42. (Previously presented) A method for detecting an anomaly only on a top surface of a substrate, comprising:

directing a first ultraviolet radiation beam at the top surface of the substrate at a first angle measured from the normal direction to the top surface;

directing a second ultraviolet radiation beam at the top surface of the substrate at a second angle different from the first angle measured from the normal direction to the top surface;

detecting ultraviolet radiation from the first ultraviolet radiation beam; and
detecting ultraviolet radiation from the second ultraviolet radiation beam.

43. (Original) The method of claim 42, wherein the first and second ultraviolet radiation beams have a wavelength of around 266 nm.

44. (Original) The method of claim 42, wherein the first and second ultraviolet radiation beams have a wavelength of around 355 nm.

45. (Original) The method of claim 42, wherein the substrate comprises a silicon-on-insulator wafer.

46. (Currently amended) A method for detecting an anomaly on a surface of a substrate, or within the substrate, comprising:

directing a first radiation beam to illuminate a first spot on the surface of the substrate at an oblique angle to the surface, said first beam having a ultraviolet or deep ~~first-ultraviolet~~ first wavelength;

directing a second radiation beam having a second wavelength to illuminate a second spot on the surface of the substrate at a second angle measured from the normal direction to the surface, wherein the second wavelength is greater than the first wavelength, so that radiation from the second beam penetrates the surface of the substrate by a distance greater than that by radiation from the first beam;

causing relative motion between the first and second radiation beams and the surface of the substrate so that the ~~first beams~~ scans ~~a paths~~ on the surface; and

detecting radiation from the first and second radiation beams scattered by the surface in the spots to provide ~~a single one or more~~ outputs in response to the scattered radiation in the beams ~~corresponding to a position of the first spot on the surface in the scan path;~~ and

generating from the outputs first data set(s) containing only data on anomalies at or substantially at the surface of the substrate and second data set(s) containing data on anomalies away from the surface of the substrate, so that anomalies at or substantially at the surface of the substrate are detectable independently from anomalies away from the surface of the substrate from the data sets.

47. (Previously presented) The method of claim 46, wherein said causing causes rotational and translational relative motion between the first radiation beam and the surface of the substrate.

48. Cancelled.

49. (Currently amended) The method of claim 468, further comprising comparing radiation detected from the first radiation beam to radiation detected from the second radiation beam to determine whether the anomaly comprises a COP or a particle.

50. (Currently amended) The method of claim 468, wherein the second wavelength is around 532, 266 or 355 nanometers.

51. (Currently amended) The method of claim 468, wherein the second wavelength is a wavelength in the visible spectrum of radiation.

52. (Currently amended) The method of claim 468, wherein the first wavelength is around 266 or 355 nanometers and the second wavelength is around 532 nanometers.

53. (Currently amended) The method of claim 468, wherein the first wavelength is in the ultra violet spectrum of radiation and the second wavelength is in the visible spectrum of radiation.

54. (Currently amended) The method of claim 468, wherein the second angle is around zero degrees.

55. (Currently amended) The method of claim 468, wherein the directing of a first radiation beam and the directing of a second radiation beam are performed sequentially or simultaneously.

56. (Currently amended) The method of claim 468, wherein the detecting of radiation from the first radiation beam and the detecting of radiation from the second radiation beam are performed simultaneously.

57. (Currently amended) The method of claim 468, wherein the detecting of radiation from the second radiation beam comprises detecting scattered radiation from the second radiation beam and avoiding reflected radiation from the second radiation beam.

58. (Currently amended) The method of claim 468, further comprising documenting the presence of an anomaly if the detected radiation shows an increase in the amount of scattered radiation produced by the second radiation beam.

59. (Currently amended) The method of claim 468, wherein said directing directs the second beam to a low-k dielectric material, said second beam containing a wavelength in a visible range.

60. (Currently amended) The method of claim 468, further comprising comparing radiation detected from the first radiation beam to radiation detected from the second radiation beam to determine whether the anomaly is located on the top surface or below the top surface of the substrate.

61. (Currently amended) The method of claim 468, wherein the relative motion causes the second radiation beam to scan a path on the surface, said method further comprising registering the scan paths of the spots illuminated by the first and second radiation beams.

62. (Previously presented) The method of claim 46, further comprising documenting the presence of an anomaly if the detected radiation shows an increase in the amount of scattered radiation produced by the first radiation beam.

63. (Previously presented) The method of claim 46, wherein the first beam is at an angle of around 70 degrees from a normal direction to the surface.

64. (Previously presented) The method of claim 46, further comprising collecting radiation from the first radiation beam scattered by the surface in the spot by

means of a radiation collector having an axis of rotational symmetry about a line, said collector focusing scattered radiation from the surface to the detector to produce the single output.

65. (Previously presented) The method of claim 46, wherein said directing directs the beam to the surface of a silicon-on-insulator wafer, and the detecting detects radiation scattered by the silicon-on-insulator wafer.

66. (Previously presented) The method of claim 46, wherein said directing directs the beam to the surface of an unpatterned semiconductor wafer.

67. (Currently amended) An apparatus for detecting an anomaly on a surface of a substrate, or within the substrate, comprising:

optics directing a first radiation beam to illuminate a first spot on the top surface of the substrate at an oblique angle to the surface, said first beam having a ultraviolet or deep first ultraviolet wavelength;

optics directing a second radiation beam having a second wavelength to illuminate a second spot on the surface of the substrate at a second angle measured from the normal direction to the surface, wherein the second wavelength is greater than the first wavelength, so that radiation from the second beam penetrates the surface of the substrate by a distance greater than that by radiation from the first beam;

means for causing relative motion between the first and second radiation beams and the surface of the substrate so that the first-beams scans a-paths on the surface; and

a detector detecting radiation from the first and second radiation beams scattered by the surface in the spots to provide one or more ~~a single~~ outputs in response to the scattered radiation in the beams; ~~corresponding to a position of the first spot on the surface in the scan path and~~

means for generating from the outputs first data set(s) containing only data on anomalies at or substantially at the surface of the substrate and second data set(s) containing data on anomalies away from the surface of the substrate, so that anomalies at

or substantially at the surface of the substrate are detectable independently from anomalies away from the surface of the substrate from the data sets.

68. (Previously presented) The apparatus of claim 67, wherein said causing means comprises an instrument that causes rotational and translational relative motion between the first radiation beam and the surface of the substrate.

69. Cancelled.

70. (Currently amended) The apparatus of claim 67, further comprising means for comparing radiation detected from the first radiation beam to radiation detected from the second radiation beam to determine whether the anomaly comprises a COP or a particle.

71. (Currently amended) The system of claim 67, further comprising a beamsplitter to separate the first radiation beam from the second radiation beam.

72. (Currently amended) The system of claim 67, wherein the first wavelength is around 266 or 355 nanometers and the second wavelength is around 532 nanometers.

73. (Currently amended) The system of claim 67, wherein the first wavelength is a wavelength in the ultraviolet spectrum of radiation and the second wavelength is a wavelength in the visible spectrum of radiation.

74. (Previously presented) The system of claim 73, further comprising at least one mirror mounted to direct the first radiation beam at the surface at a first angle measured from normal and to direct the second radiation beam at the surface at a second angle measured from normal.

75. (Currently amended) The system of claim 67, wherein the second angle is around zero degrees.

76. (Previously presented) The system of claim 67, further comprising a collector having an axis of rotational symmetry about a line, said collector receiving and directing scattered radiation to the detector to produce the single output.

77. (Previously presented) The system of claim 67, wherein the optics comprises a laser source.

78. (Previously presented) The system of claim 67, wherein the first wavelength is around 266 or 355 nanometers.

79. (Previously presented) The system of claim 67, wherein the first beam is at an angle of around 70 degrees from a normal direction to the surface.

80. (Previously presented) The system of claim 67, wherein the optics comprises a solid-state laser.

81. (Previously presented) A method for detecting an anomaly on a surface of a substrate comprising a low k dielectric material, or within the substrate, comprising:

directing a first radiation beam having a first wavelength to illuminate a first spot on the surface of the substrate at a first angle measured from the normal direction to the surface;

directing a second radiation beam having a second wavelength to illuminate a second spot on the surface of the substrate at a second angle measured from the normal direction to the surface, wherein the two beams reach the low k dielectric material, and wherein the two wavelengths are not equal and are in a visible range;

detecting radiation from the first radiation beam scattered by the top surface in the first spot; and

detecting radiation from the second radiation beam scattered by the top surface in the second spot.

82. (Previously presented) The method of claim 81, further comprising causing relative motion between the first and second radiation beams and the surface of the substrate so that the beams scan paths on the surface, wherein the detecting detects radiation from the first radiation beam scattered by the surface in the first spot to provide a first single output in response to the scattered radiation in the first beam corresponding to a position of the first spot on the surface in one of the scan paths, and to provide a second single output in response to the scattered radiation in the second beam corresponding to a position of the second spot on the surface in one of the scan paths.

83. (Previously presented) The method of claim 23, wherein said directing directs the beam to the surface of a silicon-on-insulator or unpatterned semiconductor wafer, and the detecting detects radiation scattered by the silicon-on-insulator or unpatterned semiconductor wafer.

84. (Previously presented) The method of claim 1, wherein said directing directs the beam to the surface of an unpatterned semiconductor wafer.

85. (Previously presented) The method of claim 1, further comprising registering the scan paths of the spots illuminated by the first and second radiation beams.